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$$-\frac{ac}{2r}\int dx\sqrt{(x^2+\tfrac{1}{4}a^2)}-\frac{c}{r}\int x^2dx\,\log\left(\frac{c+\sqrt{(x^2+c^2)}}{2x}\right)$$

$$=a^2c\left(1-\frac{a}{6r}[\sqrt{2}+\log(1+\sqrt{2})]\right).$$

Also solved by the *PROPOSER*.

II. Solution by G. W. GREENWOOD, B. A., Professor of Mathematics and Astronomy, McKendree College, Lebanon, Ill.

Take the center of the grindstone as origin, *Oz* being the axis, and *Ox*, *Oy* being perpendicular to the sides of the opening. Using z, r, θ coördinates, the limits will be, respectively,

$$\frac{cd-2r(c-b)}{2d},\quad \frac{a}{2\cos\theta},\quad \tfrac{1}{4}\pi.$$

$$V=16\int\int\int rdzdrd\theta==\frac{8}{d}\int\int[cdr-2r^2(c-b)]drd\theta=ca^2\int\frac{d\theta}{\cos^2\theta}$$

$$-\frac{2a^3(c-b)}{3d}\int\frac{d\theta}{\cos^3\theta}=ca^2-\frac{a^3(c-b)}{3d}[\sqrt{2}-\log\tan\tfrac{1}{8}\pi].$$

159. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College Defiance, Ohio.

Solve $\dfrac{d^2u}{dx^2}=\dfrac{1}{m}\left(\dfrac{du}{dt}\right)$.

I. Solution by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

This is solved in Forsyth's *Differemtial Equations*, Edition of 1885, Art. 259, where a^2 is the "*m*" of this problem, and is by Poisson's extension of a method due originally to Laplace. In the article referred to we have given

$$u=\pi^{-\frac{1}{2}}\int_{-\infty}^{\infty}e^{-u^2}f(x+2uat^{\frac{1}{2}})du,$$

with "another form may be given to this result by substituting λ for $x+2uat^{\frac{1}{2}}$. Then u becomes

$$\frac{1}{2a(\pi t)^{\frac{1}{2}}}\int_{-\infty}^{\infty}e^{-[(x-\lambda)^2/4a^2t]}f(\lambda)d\lambda.$$

Now $f(\lambda)$ is an arbitrary function; if we choose to assume its value to be zero everywhere except when $\lambda=r$, and then write $f(\lambda)d\lambda=H$, we have

$$u=\frac{H}{2a(\pi t)^{\frac{1}{2}}}e^{-[(x-r)^2/4a^2t]}."$$

II. **Solution by L. C. WALKER, A. M., Graduate Student, Leland Stanford Jr. University, Cal.**

The equation may be written

$$\left[\frac{d}{dt}-m\left(\frac{d}{dx}\right)^2\right]u=0;\text{ from which } u=\left(\frac{d}{dt}-m\frac{d^2}{dx^2}\right)^{-1}0.$$

By integrating with respect to t, we get

$$u=e^{mt(d^2/dx^2)}\phi(x)=\phi(x)+mt\frac{d^2\phi(x)}{dx^2}+\frac{m^2t^2}{1.2}\frac{d^4\phi(x)}{dx^4}+\dots\text{ etc.}$$

By integrating with respect to x we shall have two arbitrary functions of t, since the differential with respect to x is of the second order. Now writing the equation in the form

$$\left[\frac{d}{dx}-\frac{1}{m^{\frac{1}{2}}}\left(\frac{d}{dt}\right)^{\frac{1}{2}}\right]\left[\frac{d}{dx}+\frac{1}{m^{\frac{1}{2}}}\left(\frac{d}{dt}\right)^{\frac{1}{2}}\right]u=0,$$

we obtain $u=e^{\sqrt{[(1/m)(d/dt)]}x}\phi(t)+\varepsilon^{-\sqrt{[(1/m)(d/dt)]}x}\psi(t)$

$$=F(t)+\frac{1}{m}\frac{x^2}{1.2.3}\frac{dF(t)}{dt}+\frac{1}{m^2}\frac{x^4}{1.2.3.4}\frac{d^2F(t)}{dt^2}+\dots\text{ etc.}$$

$$+xf(t)+\frac{1}{m}\frac{x^3}{1.2.3}\frac{df(t)}{dt}+\frac{1}{m^2}\frac{x^5}{1.2.3.4.5}\frac{d^2f(t)}{dt^2}+\dots\text{ etc.,}$$

where $\phi(t)+\psi(t)=F(t)$, and $(d/dt)^{\frac{1}{2}}[\phi(t)-\psi(t)]=f(t)$.

This is the equation for determining the linear transformation of *heat* in an infinite solid.

Also solved by *G. B. M. ZERR*, and *M. E. GRABER*.

MECHANICS.

149. **Proposed by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, England.**

From two points in the same horizontal line hangs a light inextensible string, on which are threaded two beads of equal mass. The beads start from rest in the position in which the terminal portions of the string are vertical and move symmetrically towards each other in the vertical plane. Find the path of each bead, and the tension of the string at any point in the path.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Let A, B be the points from which the weightless string hangs; D, C the position of the beads when the string is stretched and the beads are on the point of starting so that AD, BC are vertical; let the mid-point of KL be the origin; E, F the position of the beads at any time; $2a$=length of string; $2b=AB$; $W=$